Federal High Performance Computing - 1995 Update

Introduction

This bulletin is intended as an update to INPUT's report, "Federal High Performance Computing 1994-1999," published in December 1994. INPUT recently attended the 1995 High Performance Computing & Communications (HPCC) Conference. The purpose of the conference was to emphasize communications among manufacturers, users, academia, and government agencies. This bulletin briefly summarizes HPCC program accomplishments and issues, a recently completed study that answers congressional concerns and recommendations, and a recap of the High Performance Modernization Program at the Department of Defense, one of the more active agencies in the HPCC Program. Copies of materials received at the conference are available at INPUT's library in Vienna, Virginia.

Summary

The HPCC Program is generally well thought of by the new Congress, the Clinton Administration, academia and by industry, who believe that the long term investment in Research and Development (R&D) in high performance information technology has paid off, and has been crucial to United States

information technology (IT) and its economic leadership in the world. Most of the federal government's overall computer R&D funding resides in the HPCC budget.

While the HPCC program is not specifically mentioned in the Contract with America, it is assumed that the HPCC budget may be adjusted on an agency-by-agency basis as some unpopular applications are terminated. There is general agreement between the Clinton Administration and the new congressional leadership to continue the program. There is, however, a recommendation to stop government R&D funding of computer manufacturers for hardware development. They will continue funding industry-university teams for hardware architecture research and software, algorithm and application development.

High performance computing hardware technology continues to advance on schedule toward a one teraflop capability by 1998. Software, algorithm and application development continue to lag. There currently may be more technological capability than the community knows how to use. Massively parallel processing can make software and application development more difficult, but will eventually allow for the development of

more highly data-intensive applications with much greater computational capability. The government is actively encouraging industry and university participation in the program.

HPCC Program Accomplishments

Some interesting technology trends and program accomplishments were presented at the HPCC conference. According to the National Research Council of the National Academy of Sciences, the HPCC program has:

- made parallel computing widely accepted as a practical route to achieving high performance computing

- demonstrated the feasibility of parallel databases; initiated deployment of these databases

- drove progress on challenges such as cosmology, molecular biology, chemistry and materials sciences

- developed new computational means in earth sciences, medicine and engineering

- demonstrated gigabit network testbeds and advanced network backbones of Internet to keep up with the yearly doubling of the network

- organized transition of the Internet backbone to the private sector, and

- created Mosaic Browser for the World Wide Web which increases access to the Internet.

According to Dr. Larry Smarr, director of the National Science Foundation's (NSF) National Center for Supercomputing Applications (NCSA), there have been huge improvements in high performance computing over the last ten years: speed has increased over 150 fold, memory sizes have increased over 700 fold, and parallelism has increased over 80 fold. "Considering algorithm improvements,

researchers are now able to study phenomena 1000 times more complex." Many new HPCC applications will be discussed in the soon-to-be-republished document, "HPCC: Technology for the National Information Infrastructure," available from the HPCC National Coordinating Office (NCO) at (301) 402-4100.

Issues

There are numerous concerns involved in any project as large and complex as the HPCC program. These are well recognized by the HPCC National Coordinating Office (NCO) and the agencies and are being addressed in strategic planning and implementation plans. Many of the issues will be handled as a result of the recommendations forwarded by the "Evolving HPCC Study," conducted by the National Research Council's Computer Science and Telecommunications Board.

A primary concern, of course, is the status of the HPCC budget in Congress. R&D budgets need to be planned many years into the future. Typically, it takes five to ten years for R&D efforts to emerge into the marketplace. Companies in the computer industry think in terms of three to five years for technology in development to become a profitable product. The HPCC program needs to know how quickly systems can be made operational in order to show Congress that an R&D activity is either contributing directly to an agency's critical mission, or meeting some crucial societal problem. The program needs more rapid systems development; the next 100 days in the new political environment in Congress should tell which HPCC agency applications will remain funded and at what level.

The balance of private versus public investments in HPCC continues to be a concern. The government is increasing efforts to work closely with vendors and academia to encourage additional participation. The HPCC program needs teams to develop software, national (information intensive) and

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grand (computational intensive) challenge application systems software and the ability to incorporate third party code. The HPCC Advisory Committee will ensure that coordination efforts are stepped up.

Some members of the HPCC program believe that in the effort to attain the goal of one teraflop supercomputing by the year 1998, some vendors will drop out of the race. They believe that the market will be unforgiving to vendors who do not understand the concept of "metacomputing," that is, the systems integration of multiple computers to do a single function for a user.

It is difficult to predict the success and societal impact of many of the applications being developed under the HPCC umbrella. We will see increased emphasis on quickly bringing up new applications that are acceptable to Congress, and on the education of new people, policy makers, organizations and new users.

The extremely rapid acceptance and growth of the Internet has caused some participants to predict the "meltdown" of the network before the year 2000–a difficult prediction at this time because of activities underway to privatize the network. Success of Internet and the World Wide Web depends on the speed of users' computers, the speed and capacity of servers, and on the bandwidths provided by the telecommunications companies. World Wide Web servers are needed to link all HPCC participating sites. Security is being addressed in the National Information Infrastructure (NII) Security Plan.

HPCC: Status of a Major Initiative

An April, 1995 study by the Computer Sciences and Telecommunications Board, National Research Council at the National Academy of Sciences, addresses congressional queries on the status of the HPCC program. Results of the study are published in a document entitled, "Evolving the HPCCI to

support the nation's Information Infrastructure." This document can be obtained from the National Academy Press by calling (800) 624-6242 or by ordering it via the Internet: AMERCHAN@NAS.EDU. The report itself can be accessed on the Internet as follows:

> FTP.NAS.EDU
> GOPHER.NAS.EDU
> HTTP://WWW.NAS.EDU

Congress has questioned the HPCC program's basic underlying rationales, including the balance between various elements of the program, the effectiveness of obtaining input from the industry and users, the management and coordination of the program acquisitions and other federal support of HPCC, and the likelihood of achieving success in the program.

Study Results

The study found that most of the funding for computing research is found under the HPCC program and that any challenge to or question of continued funding would be a catastrophic loss to U.S. information technological leadership. The study also states that government funding should be used on technological development that pushes the limits of high performance computing. Projects should be chosen only if they address agency mission accomplishment and/or societal problems.

Specifically, the study found that the HPCC program goals and direction have proved highly productive and should not be stopped. HPCC has advanced U.S. information technology leadership, which has become critical to the U.S. economy. The balance of efforts between the private and public sector is appropriate, but government funded research in computer hardware should be done by universities. Hardware architecture, software and algorithm research can be shared among

teams of private industry, academia and government.

Study Recommendations

The board has recommended to Congress to continue support of research and development in information technology and the HPCC program, especially maintaining the emphasis on the National Information Infrastructure (NII). It recommended continuing a strong experimental research program on software and algorithm development for parallel computing machines, but to stop funding commercial research by computer vendors on hardware. The board supports industry-university collaborations in computer architecture and application software research. The teraflop computer should be treated as a research direction, and the government should increase the HPCC focus on communication and network research. The program should develop a research program to build very large, reliable, high performance, distributed information systems, and ensure that HPCC focuses on National Challenge applications that contribute to the development of NII technologies. Grand Challenge applications should be funded when they contribute to the development of new HPCC hardware or software.

The board also recommended continued funding for the NSF supercomputer centers, but access to maturing architectures at the centers by application scientists should be gradually withdrawn from funding.

The study recommends the appointment of a congressionally mandated advisory committee consisting of industry/academia/government personnel, and that the HPCC National Coordinating Office be strengthened by a full-time director. These steps have begun to be implemented with the appointment of John Toole (formerly of ARPA) to be the new, full-time director of the NCO.

Finally, the board recommends that computer purchases be based only on each agency's mission needs and that the acquisition decisions be made at the lowest practical level.

HPCC Strategic Plan and Funding

According to John Toole, director of the HPCC National Coordination Office, the vision of the Clinton Administration is for the "acceleration of the evolution of existing technology and innovation that will enable universal, accessible, affordable application of information technology to ensure America's economic and national security in the 21st Century." The Committee on Information and Communication (CIC) under the president's National Science and Technology Council (NSTC) has completed a draft strategic plan which has as primary focus areas: global-scale information infrastructure technologies, high performance/scalable systems, high confidence systems, virtual environments, user centered interfaces and tools, human resources and education.

This strategic plan and the newly republished "HPCC: Technology for the National Information Infrastructure" document can be obtained at the NCO by calling (301) 402-4100.

HPCC Budget

HPCC budget cuts can be expected on an agency-by-agency basis, depending on certain applications' popularity in Congress. Numerous HPCC applications are well thought of, such as weather and climate predictions, design, manufacturing, visualization and medical research. Department of Defense applications, discussed below, remain a high funding priority.

HPCC Budget

Agency	FY 1996 Request ($Millions)
ARPA	363
NSF	314
DOE	114
NASA	131
NIH	78
NSA	40
NIST	34
NOAA	16
EPA	12
ED	17
VA	24

Source: HPCC NCO

DoD High Performance Computing Modernization Plan (HPCMP)

The Department of Defense is actively proceeding on its modernization plan across the military departments. Laboratories, agencies, Congress and the GAO support the program. The acquisitions are proceeding on schedule.

The DoD is basing all procurements on agency mission needs. The department differs from the other HPCC agencies due to its wide range of very complex applications, such as signal and image processing, computational fluid dynamics, forces modeling/simulation on C4I, environmental quality modeling and simulation, computational electronics and nanoelectronics. The department is also building a common library of scalable application software.

High performance software tools and programming are weak and immature. The basic technology in DoD is good, but more work is needed in design, test and evaluation activities. The existing systems meet 22% of DoD user requirements for approximately 3,000 users across 50 laboratories.

DoD plans to spend $60 million for distributed centers in 1995–1996. This involves highly classified real-time and near real-time applications, including distributed data storage and visualization technologies.

The DoD Modernization Program includes two major acquisitions: the Major Shared Resource Centers (MSRC) procurement is currently underway and the Defense Research & Engineering Network (DREN) draft RFP will be released shortly. DRN will build up the network from 50 labs and agencies currently more than 150 locations in a high performance environment. The funding is a mix of R&D and procurement dollars:

Exhibit 2

R&D Procurement Expenditures

Year	Funding ($Millions)
1995	154
1996	198
1997	232
1998	204
1999	309
2000	322
2001	335

Source: DoD HPCC Modernization Program

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